We claim:

1. A method to determine amniotic fluid volume in digital images, the method comprising:

positioning an ultrasound transceiver to send and receive echoes from a portion of a uterus of a patient, the transceiver adapted to form a plurality of scanplanes;

enhancing the images of the amniotic fluid regions in the scanplanes with a plurality of algorithms;

associating the scanplanes into an array, and

determining the amniotic fluid volume of the amniotic fluid regions within the array.

2. The method of Claim 1, wherein plurality of scanplanes are acquired from a rotational array, a translational array, or a wedge array.

3. The method of Claim 1, wherein the plurality of algorithms includes algorithms for image enhancement, segmentation, and polishing.

4. The method of Claim 3, wherein segmentation further includes an intensity clustering step, a spatial gradients step, a hysteresis threshold step, a Region-of-Interest selection step, and a matching edges filter step.

5. The method of Claim 4, wherein the intensity clustering step is performed in a first parallel operation, and the spatial gradients, hysteresis threshold, Region-of-Interest selection, and matching edges filter steps are performed in a second parallel operation, and further wherein the results from the first parallel operation are combined with the results from the second parallel operation.

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6. The method of Claim 3, wherein image enhancement further includes applying a heat filter and a shock filter to the digital images.

7. The method of Claim 6 wherein the heat filter is applied to the digital images followed by application of the shock filter to the digital images.

8. The method of Claim 1, wherein the amniotic fluid volume is adjusted for underestimation or overestimation.

9. The method of Claim 8, wherein the amniotic fluid volume is adjusted for underestimation by probing with adjustable ultrasound frequencies to penetrate deep tissues and to repositioning the transceiver to establish that deep tissues are exposed with probing ultrasound of sufficient strength to provide a reflecting ultrasound echo receivable by the transceiver, such that more than one rotational array to detect deep tissue and regions of the fetal head are obtained.

10. The method of Claim 8, wherein amniotic fluid volume is adjusted for overestimation by automatically determining fetal head volume contribution to amniotic fluid volume and deducting it from the amniotic fluid volume.

11. The method of Claim 10, wherein the steps to adjust for overestimated amniotic fluid volumes include a 2D clustering step, a matching edges step, an all edges step, a gestational age factor step, a head diameter step, an head edge detection step, and a Hough transform step.

12. The method of Claim 12, wherein the Hough transform step includes a polar Hough Transform step, a Find Maximum Hough value step, and a fill circle region step.

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13. The method of Claim 12, wherein the polar Hough Transform step includes a first Hough transform to look for lines of a specified shape, and a second Hough transform to look for fetal head structures.

14. A method to determine the volume of structures in digital images, the method comprising:

positioning an ultrasound transceiver exterior to a patient at a plurality of patient locations orientated at approximately the same orientation such that at least a portion of the structure is within the range of the transceiver to send and receive echoes from the portion of a structure;

transmitting radio frequency ultrasound pulses distributed as 2D scanplanes, each scanplane having a plurality of scanlines, to, and receiving those pulses echoed back from, the internal and external boundaries of the structure; and, based on those pulses

a) enhancing the image of the structure in each scanplane;

b) forming a 3D array of scanplanes for each patient location;

c) aligning a common portion of images in similarly orientated scanplanes from adjacent 3D arrays;

d) fusing the images from similarly orientated scanplanes from adjacent 3D arrays and forming a mosaic 3D array, and

e) calculating the volume of the structure in the mosaic 3D array.

15. The method of Claim 14, wherein the structure is a uterus, the internal boundary is between the amniotic fluid and tissue, the plurality of patient locations is four such that a first 3D array is obtained from a first transceiver location, a second 3D array

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is obtained from a second transceiver location, a third 3D array is obtained from a third transceiver location, and a fourth 3D array is obtained from a fourth transceiver location, each 3D array having the similarly orientated scanplanes of substantially the same ϕ and rotation θ angles.

16. The method of Claim 15, wherein the identification of the common portion of the amniotic fluid images is by selection of low intensity pixels at the internal boundary along the amniotic fluid in scanplanes having substantially the same ϕ and rotation θ angles from the first, second, third, and fourth 3D arrays.

17. The method of Claim 16, wherein the aligning and fusing of the common portion of images in scanplanes having substantially the same same ϕ and rotation θ angles from the first and second 3D arrays comprises:

a) determining and applying a 3D distance transform that brings the low intensity pixels of a second image to closest proximity to the low intensity pixels of a first image that is common with the second image, and

b) repeating step (a) as necessary to achieve closest proximity as shown to be a minimum change in location of the low intensity pixels, then fusing the second image to the first image.

18. The method of Claim 17, wherein the aligning and fusing of the common portion of images in scanplanes having substantially the same same ϕ and rotation θ angles from the second and third 3D arrays comprises:

a) determining and applying a 3D distance transform that brings the low intensity pixels of a third image to closest proximity to the low intensity pixels of the second image that is common with the third image, and

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b) repeating step (a) as necessary to achieve closest proximity as shown to be a minimum change in location of the low intensity pixels, then fusing the third image to the second image.

19. The method of Claim 19, wherein the aligning and fusing of common portion of images in scanplanes having substantially the same same ϕ and rotation θ angles from the third and fourth 3D arrays comprises:

a) determining and applying a 3D distance transform that brings the low intensity pixels of a fourth image to closest proximity to the low intensity pixels of the third image that is common with the fourth image, and

b) repeating step (a) as necessary to achieve closest proximity as shown to be a minimum change in location of the low intensity pixels, then fusing the fourth image to the third image.

20. The method of Claim 19, wherein the patient is in a supine position and the 3D arrays are obtained from the corners of a substantially rectangular grid, each corner being approximately the midpoint of a uterine quadrant.

21. The method of Claim 19, wherein the patient is in a lateral position and the 3D arrays are obtained along a line over the uterus, each 3D array being separated from the other by a measurable interval.

22. The method of Claim 14, wherein the transceiver is further adapted to measure the tilt ϕ and rotation θ angles differences and to further adjust the tilt ϕ and rotation θ angles between locations to be approximately the same.

23. The method of Claim 22, wherein the tilt ϕ and rotation θ angles are measured by an accelerometer.

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24. A method to determine the volume of structures in digital images, the method comprising:

positioning an ultrasound transceiver exterior to a patient at a plurality of patient locations such that at least a portion of the structure is within the range of the transciever to send and receive echoes from a portion of a structure;

transmitting radio frequency ultrasound pulses delivered as 3D-distributed scanlines to, and receiving those pulses echoed back from, the internal and external boundaries of the structure; and, based on those pulses

a) forming a three-dimensional scancone for each patient location;

b) enhancing the structural image in each scancone;

c) aligning a common portion of the structure between adjacent scancones;

d) fusing the aligned scancones to form a 3D mosaic image, and

e) calculating the volume of the structure in the 3D mosaic image.

25. The method of Claim 24, wherein the structure is a uterus, the internal boundary is between the amniotic fluid and tissue, the plurality of patient locations is four such that a first scancone is obtained from a first transceiver location, a second scancone is obtained from a second transceiver location, a third scancone is obtained from a third transceiver location, and a fourth scancone is obtained from a fourth transceiver location.

26. The method of Claim 25, wherein the identification of the common portion of the amniotic fluid images is by selection of low intensity pixels at the internal boundary along the amniotic fluid in the first, second, third, and fourth scancones.

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27. The method of Claim 26, wherein the aligning and fusing of the common portion for the first and second scancones comprises:

a) determining and applying a 3D distance transform that brings the low intensity pixels of the second scancone to closest proximity to the low intensity pixels of the first scancone that is common with the second scancone, and

b) repeating step (a) as necessary to achieve closest proximity as shown to be a minimum change in location of the low intensity pixels, then fusing the second scancone to the first scancone.

28. The method of Claim 27, wherein the aligning and fusing of the common portion for the second and third scancones comprises:

a) determining and applying a 3D distance transform that brings the low intensity pixels of the third scancone to closest proximity to the low intensity pixels of the second scancone that is common with the third scancone, and

b) repeating step (a) as necessary to achieve closest proximity as shown to be a minimum change in location of the low intensity pixels, then fusing the third scancone to the second scancone.

29. The method of Claim 28, wherein the aligning and fusing of the common portion for the third and fourth scancones comprises:

a) determining and applying a 3D distance transform that brings the low intensity pixels of the fourth scancone to closest proximity to the low intensity pixels of the third scancone that is common with the fourth scancone, and

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b) repeating step (a) as necessary to achieve closest proximity as shown to be a minimum change in location of the low intensity pixels, then fusing the fourth scancone to the third scancone.

30. The method of Claim 29, wherein the patient is in a supine position and the scancones are obtained from the corners of a substantially rectangular grid, each corner being approximately the midpoint of a uterine quadrant.

31. The method of Claim 29, wherein the patient is in a lateral position and the scancones are obtained along a line over the uterus, each scancone being separated from the other by a measurable interval.

32. A system for determining amniotic fluid volume, the system comprising:

a transceiver positioned on at least one location of a patient, the transceiver configured to deliver radio frequency ultrasound pulses to amniotic fluid regions of a patient, to receive echoes of the pulses reflected from the amniotic fluid regions, to convert the echoes to digital form, and to determine the tilt and rotational orientations of the ultrasound pulses;

a computer system in communication with the transceiver, the computer system having a microprocessor and a memory, the memory further containing stored programming instructions operable by the microprocessor to associate the plurality of scanplanes into a rotational array, and

the memory further containing instructions operable by the microprocessor to determine the presence of an amniotic fluid region in each scanplane and determine the amniotic fluid volume spanning between and through each scanplane of the rotational array.

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33. The system of Claim 32, wherein tilt and rotational orientations of the ultrasound pulses is determined by an accelerometer in the transceiver, the accelerometer configured to measure differences in the angular positions of the transceiver.

34. The system of Claim 32, wherein each scanplane is arranged as a plurality of scanlines, each scanline of the plurality of scanlines being separated by approximately 1.5 degrees and having a length suitable for the dimension of amniotic fluid region.

35. The system of Claim 34, wherein scanplanes have similar orientations from a plurality of transceiver locations

36. The system of Claim 32, wherein the programming instructions include a plurality of algorithms for image enhancement, segmentation, and polishing.

37. The system of Claim 36, wherein the steps for image enhancement further include application of a heat filter followed by application of a shock filter.

38. The system of Claim 32, wherein the amniotic fluid volumes are adjusted for underestimation and overestimation.

39. The system of Claim 38, wherein the amniotic fluid volumes are adjusted for underestimation by probing with ultrasound frequencies having sufficient power and wavelength to penetrate through fatty tissue to reach amniotic fluid regions and to provide detectable echo signals receivable to the transceiver to reveal amniotic fluid regions.

40. The system of Claim 39, wherein the amniotic fluid volumes are further adjusted for underestimation by repositioning the transceiver to acquire more than one rotational array to detect deep tissue and regions of the fetal head.

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41. The system of Claim 38, wherein the amniotic fluid volumes are adjusted for overestimation by detecting the location of a fetal head, determining the volume of the fetal head, and deducting the volume of the fetal head from the amniotic fluid volume spanning between and through each scanplane of the rotational array.

42. The system of Claim 32, wherein the computer system is configured for remote operation via an Internet web-based system, the internet web-based system having a plurality of programs that collect, analyze, and store amniotic fluid volume.

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